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ETHER DEATH:

A PERSONAL EXPERIENCE IN FOUR CASES OF DEATH FROM
ANÆSTHETICS.

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Drs. Henry H. Smith, R. J. Levis, Laurence Turnbull, H. C. Wood, Roberts Bartholow,
Albert H. Smith, John H. Packard, A. Schaplinger, W. R. D. Blackwood, S. L. West,
Charles B. Nancrede, M. O'Hara, Charles K. Mills, Joseph Hearn, and others.

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ETHER DEATH:

A PERSONAL EXPERIENCE IN FOUR CASES OF DEATH FROM ANÆSTHETICS.

IT has been my fortune on four occasions to witness the occurrence of death during or immediately after the production of anæsthesia. In three of these instances sulphuric ether was employed; in the other, bromide of ethyl. In none of the cases, however, was I the administrator of the anæsthetic, but merely a by-stander or an assistant in the efforts at resuscitation. On numerous other occasions I have seen patients almost die from the effects of chloroform or other anæsthetics, who were fortunately revived by well-directed treatment. These circumstances have been called to mind, many times with considerable anxiety, when resorting to anæsthesia in the performance of surgical operations; and I therefore desire to report in full the case of ether death which recently occurred under my observation. Afterwards I shall refer to the three other cases spoken of, which have been already recorded by myself or others; and finally I shall offer some remarks as to ether deaths in general.

Case I.—Death from Cardiac Failure after Etherization.

The patient, a woman, aged 26 years, was admitted to Dr. R. J. Levis's ward, in the Jefferson College Hospital, with fibrous anchylosis of the right knee and hip, occurring subsequently to arthritis, considered by her physician to be rheumatic in character. The trouble had existed about a year, and Dr. S. L. West, of Wilmington, had treated her also for chronic uterine disease, rheumatism, cardiac palpitation, and nervous prostration.

After she had been in the hospital for two days, she was placed upon the operating-table (on January 20, 1881) for the purpose of having the fibrous joint-adhesions broken up by passive motion. When she was brought into the room she was frightened and very nervous, which was attributed partly to the fact that, before she entered, a very boisterous sailor, just recovering from ether, was re-

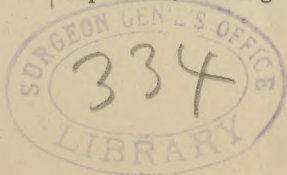
moved. She was asked if she had ever taken ether, and replied that she had often done so. I then, as Dr. Levis's assistant, placed my ear to the cardiac region to ascertain the condition of the heart before the resident surgeon began etherization. As I did so, she exclaimed, "I have a bad heart," referring, no doubt, to cardiac symptoms, such as palpitation, which she had experienced. Of these symptoms I had known nothing, and auscultation was begun merely as a precautionary measure. Her remark, therefore, made me listen with more care, perhaps, than I otherwise would have done. The heart's action was rapid and tumultuous, as would be expected from her excited condition, and I thought I detected an indistinct murmur. Nothing sufficient to contra-indicate anæsthesia appeared to be present.

The resident physician (Dr. York) then began to etherize slowly, using Squibb's ether poured on a couple of towels. The patient did not at first breathe very deeply, but in a short time passed into a condition of anæsthesia without the least struggling. Dr. Levis then broke up the adhesions of the hip and knee, using a mallet to loosen the patella, which was quite firmly attached to the condyles. In these manipulations I assisted, being at the foot of the bed, and, hence, away from observation of the patient's respiration and pulse.

Soon the anæsthetic was suspended, and an extension-apparatus of adhesive plaster adjusted to the limb. The time occupied in etherizing, operating, applying the plaster, and removing the patient to the ward was about half an hour (2 P.M. to 2.30 P.M.). There was no vomiting.

After the limb had been placed in position, and just before the woman was taken from the operating-table, while she appeared to be quietly sleeping, I placed my finger upon the right pulse and was astonished at its feebleness and frequency. I immediately called the resident's attention to the fact, and informed the operator of the unfavorable condition of circulation.

We all followed her bed to the ward. She had not awakened up to this time, but was unconscious, and was breathing quietly and regularly. If it had not been for the cardiac depression, nothing would have given the



alarm or caused apprehension. The pulse was feeble and beating 180-200 per minute, while the regular, quiet respirations numbered about 22. As the symptoms did not improve, twenty drops of tincture of digitalis with enough whisky to fill the syringe twice (f3j approximately) were given hypodermically at 2.35 P.M. At 2.42 P.M. an enema of about six fluidounces of whisky was administered, and twelve minutes later (2.54 P.M.) I gave a hypodermic injection of tincture of digitalis (℥x) and sulphate of atropia (gr. $\frac{1}{30}$). Then the faradic battery, which had been brought to the bedside, was suggested as a remedial agent, but, as the respiration was continuing comparatively unaffected, it was only applied for a short time, with one pole to the neck, the other in the præcordial region. After the hypodermic of digitalis and atropia I thought the pulse became a little stronger, but this observation may have been incorrect. At any rate, in a short time the progressive cardiac failure was so patent that at 3.10 P.M. ten minims of tincture of digitalis were injected by me into the subcutaneous tissue of the breast. Ten minutes later (3.20 P.M.) atropia sulphate (gr. $\frac{1}{60}$) was injected into the mammary region, and an enema of strong hot coffee (f3viij-x) administered.

Before these remedies were given, cyanosis of the hands was exhibited, and at about the same time respiration became somewhat irregular. The pupils were not dilated.

The patient continued to sink, and at 3.32 P.M., when respiration was almost gone, a final hypodermic injection was given, consisting of atropia, gr. $\frac{1}{60}$; tincture of digitalis, ℥x; whisky, ℥xxx. At 3.35 P.M. the patient died quietly, without having shown signs of consciousness, and, I think I am correct in saying, without voluntary motion of the limbs, from the time anæsthesia was produced.

After death an effort was made to determine the exact quantity of ether given. A new can of Squibb's ether had been opened before etherizing the previous patient, who was a powerful sailor requiring amputation of a finger, and to whom an additional quantity of the anæsthetic was given after he had partially regained consciousness, in order to insert the sutures and dress the wound. It was the noise of this boisterous patient, before he left the operating-room, that increased the alarm of the unfortunate patient who followed him. After the man and the woman had been operated upon, it was found that only six ounces avoirdupois of ether had been removed from the can. It seems fair, then, to estimate the amount taken by the woman, to whom it was not given with as free a hand, at two and a half or three

ounces avoirdupois, or about three and a half fluidounces.

I may state also that the quantities of digitalis and atropia were accurately measured by the piston of the hypodermic syringe; but, as is well known, these are frequently marked incorrectly.

The autopsy was made by Dr. Morris Longstreth, the pathologist of the Hospital, twenty-one hours after death.

There was a small amount of pleural, but almost no pericardial, effusion. The heart-cavities contained fluid blood, and neither ventricle was firmly contracted. The right auricle was slightly dilated; the left thickened, and its cavity dilated, especially in the auricular appendage. The right ventricular wall was thickened and the cavity dilated, especially towards the artery. The left ventricle showed no special change. The coronary veins were filled with blood, and two spots of ecchymosis were seen on the surface of the heart. The cardiac muscle was much softened. The valves of the right side were normal, though the auriculo-ventricular orifice was dilated. The mitral leaflets were normal, with the exception of one or two patches of thickening; the orifice, however, was dilated. The aortic valves were competent, and showed no evidence of thickening, though a small fenestra was found in one leaflet. The aortic sinuses seemed pouched. The oval fossa presented an oblique opening large enough to allow the passage of an ordinary wooden lead-pencil.

Some remains of the thymus gland were visible. The lungs crepitated poorly, and were congested posteriorly; anteriorly they were pale in color. No evidence of œdema. Both lower lobes posteriorly were softened, but not granular. Section of the lung-structure showed no other conditions. The spleen presented no special change. No odor of ether was perceptible about the viscera. Left kidney was irregular, moderately firm, and deeply congested, showing, on section, no alteration of cortex, but having an adherent capsule and some subcapsular ecchymoses. The surface was but slightly granular. At several points in the pyramidal portion areas of softening from which drops of mucoid material could be pressed were seen. Right kidney was softened, and presented same condition as noted in left.

Liver had smooth surface, was moderately congested and somewhat softened. On the anterior surface of the right lobe, near the middle, was situated a non-protruding cyst, an inch in diameter, filled with dirty-brown gelatinous material. The interior of this cyst was lined with an opaque, smooth, white membrane. The ovaries showed marked cystic disease; the cyst of the left ovary was as large as a small walnut, and contained blood.

A catheter was introduced into the bladder to obtain some urine for analysis, but the bladder was empty.

A marked feature of the examination was the fact that almost every organ presented some noticeable change; but in none were these alterations characteristic of any distinct disease.

Microscopic Examination.—The heart-muscle presented evidences of granular and fatty degeneration; and none of the fibres showed normal striation. On teasing out the fibres, large numbers of oil-drops were liberated.

The appearances presented by sections of lung-tissues were very similar to those of embolism. The smaller arteries and capillaries were packed with blood-corpuscles and rendered tortuous; yet no embolus of fat or blood could be found. The lung epithelium showed no changes, but the peribronchial connective tissue was increased.

The capsule of the kidneys showed no evidence of thickening. The arteries appeared slightly enlarged and their walls thickened. The capsules of the Malpighian bodies were thicker and firmer than usual, and around them nuclear proliferation had taken place. Within the Malpighian body proliferation was likewise occurring, similar to that seen in glomerulo-nephritis. The intertubular tissue was slightly swollen, and for the most part its nuclei were more distinct and numerous than normal. The convoluted tubes were slightly irregular in outline; their basement membranes appeared unchanged; and their epithelia were swollen, markedly granular, with nuclei in most instances indistinctly visible.

The capsule of the liver was thickened, and showed active proliferation from its under surface into the interlobular connective tissue. In many of the portal canals, in the deeper portions of the organ, the connective-tissue increase was even more marked than noted above. The liver-cells appeared slightly shrunken and highly granular; their nuclei were visible, but stained poorly, and in some instances appeared almost vesicular. None of the cells showed any fatty infiltration, but on the contrary presented appearances of fatty degeneration, as evidenced by numerous small oil-globules. No changes were noticed in the interlobular vessels or ducts.

Case II.—Sudden Death after Administration of Chloral and Etherization, prior to Amputation of the Thigh.

In 1872 I witnessed a death from ether, which occurred under the following circumstances:

A man, aged 35 years, was to be subjected to amputation, for necrosis of the femur accompanied by many sinuses discharging very large amounts of pus. Twenty grains of chloral were administered immediately before the etherization, and a large amount of the anæsthetic was apparently given in a short time. In fact, the ether was pushed. Just as the amputation was to be commenced, collapse occurred and immediate death ensued.* I believe no autopsy was made. As I merely witnessed the fatal issue, I have no means of giving more accurate notes. This was at a time previous to the introduction of the elastic bandage, which was therefore of course not applied to the limb. Hence, embolism, due to forcing pus or clots into the vessels, which suggests itself, is not tenable as the cause of death.

Case III.—Death from Œdema of the Lungs after Anæsthesia by Ether.

The other case of ether death, or rather of death occurring subsequently to, but not immediately after, etherization, of which I have personal knowledge, took place in 1876. The history in brief is as follows:

A youth, aged 19 years, who had marked angular spinal curvature from caries, was admitted by Dr. T. G. Morton into the Pennsylvania Hospital for treatment of an ankylosed right knee. He was anæsthetized with two and a half or three ounces (fluid?) of ether, and subjected to tenotomy and forcible straightening of the limb. The apparatus made for the case was adjusted to the limb, and the patient, by this time conscious, was removed to his private room. He had been under the anæsthetic influence not over twenty minutes, there was no vomiting, no marked evidence of mucus collecting in the trachea or fauces, and he rapidly recovered consciousness when the ether towel was taken from his face. Fifteen minutes after removal to his room he showed alarming symptoms of asphyxia, such as cyanosis and impending cessation of respiratory motion. Dr. W. B. Hopkins and I endeavored to relieve him by depressing the tongue and dashing cold water in his face, which, however, only produced violent respiratory efforts. As the condition grew worse, and frothy, blood-stained mucus expelled from the fauces gave evidence of pulmonary engorgement, which was accom-

* See Morton's Report on Ether Deaths, in American Journal of the Medical Sciences, October, 1876, p. 415.

panied by labored cardiac action, we applied dry cups to the chest and drew about eight fluidounces of blood from the radial artery. Respiration and circulation seemed to improve somewhat from these measures; but he continued to sink, despite the subcutaneous injection of carbonate of ammonia and whisky, and died one and three-quarter hours after anæsthesia. Dr. Hopkin's had seen that he had perfectly recovered from the anæsthetic sleep before removal from the operating-room, and even during the stage of asphyxia the patient was quite rational.*

The autopsy showed a deformed thorax, due to the antecedent vertebral caries, old pleural adhesions between the lung and parietes, and the lower part of the right pleural cavity obliterated by firm adhesions between the diaphragm and costal pleura. The pleural cavities showed much serum infiltrating the meshes between the adhesions; and the lungs, pitting on pressure, exuded on section large amounts of frothy fluid, as from a saturated sponge. The lung-tissue was fairly crepitant, and floated in water. The heart-cavities contained fluid blood, while the valves and muscular tissue were normal. The great vessels at the base of the heart were healthy. No foreign body was found in the trachea or large bronchi. The kidneys were not examined.

Dr. Morton considered this patient to have died from "the mucous secretion and serous effusion which invaded every available space, thus suffocating the patient." This fatal pulmonary œdema was of course due to the inhalation of ether, since the patient was in good health when subjected to operation.

The fourth death from anæsthetics which I have seen has already been reported by me,† and occurred during the administration of bromide of ethyl. A short account of the circumstances, however, may be allowable at this time.

Case IV.—Death occurring during the Use of Bromide of Ethyl as an Anæsthetic.

A boy of 18 years was received into Dr. R. J. Levis's ward of the Jefferson College Hospital for lithotomy. He was in bad condition, and the operation was therefore delayed until tonics and corroborative treatment could be employed in the endeavor to improve his general health. Finally, upon the approach of summer weather, after several weeks' stay in the ward, he was placed upon the operating-table. He was given some whisky and fifteen grains of quinine on account of his debility, and the inhalation

of bromide of ethyl begun. He was exceedingly nervous and agitated before he commenced inspiring the anæsthetic, and struggled a good deal during its administration. Four fluidrachms of bromide of ethyl had been poured on the towel in divided quantities, when the cutaneous incision was made. Just then it was noticed that respiration was imperfect, and the towel was removed from his face. The lips were pinkish, and no marked cyanosis was noticed. As I was holding the lithotomy staff, I am unable to say what was the condition of the pulse; and the observation of the administrator of the anæsthetic is not recorded. A few feeble inspiratory efforts took place, but inversion of the patient, nitrite of amyl inhalation, artificial respiration, galvanism, and drawing forward the tongue were of no avail. The pinkish lips would perhaps point to death from syncope, but the respiratory symptoms were the first to attract attention. It may be that the pulse failed a moment previously. The autopsy showed a slight odor of the bromide of ethyl emanating from the thoracic and abdominal cavities; old pleuritic adhesions; areas of consolidated lung, containing cavities, due to catarrhal pneumonia; some dilatation of the heart, and kidney changes. The microscope showed the beginning of renal inflammation, and discovered such atrophic alterations of the heart-fibres as are often present in connection with advanced lung disease; but there was no fatty degeneration of the cardiac muscle.

Such, then, are the clinical features of the four cases of death from anæsthesia which I have witnessed. Though the pathological features of these cases and the physiological actions of ether and other anæsthetic agents could be much better discussed by other members of the Society than myself, I desire to make some general remarks on the subject of ether death. First, as to the case that forms the text of my paper. Was she a proper subject for etherization? was the anæsthetic given properly? was the after-treatment properly conducted? how did ether kill her? are questions that we must study thoughtfully, and which I offer for thorough discussion and criticism by the members of this Society.

Was she a proper subject for etherization? The patient's heart was ausculted immediately previous to the administration, and nothing found to contra-indicate ether. Indeed, even if marked organic disease be detected in patients about to be anæsthetized, it is not regarded as an absolute bar to the administration. Ether is frequently given to such patients, and J. W. Haward,

* For a more complete account see Dr. Morton's paper in *Amer. Jour. Med. Sci.*, October, 1876, p. 411.

† Philadelphia Medical Times, July 17, 1880, p. 521.

in advocating the superiority of ether to chloroform, states that he has given chloroform to persons with extensive heart disease.* Kappeler and Reeve reject† the idea that fatty degeneration of the heart is an important factor in chloroform deaths; and it would be expected to be a much less important factor in ether death. Hence, even if valvular disease or fatty degeneration had been discovered, it would not have precluded the administration. Dilatation of the heart is probably a more dangerous condition than any other when anæsthetics are to be administered. The woman had been etherized twice previously, and, according to her husband, by a much larger amount of ether than given on the fatal occasion. Her physician, Dr. S. L. West, tells me that he etherized her on the last occasion, which was fifteen months ago, without any unpleasant effects; but I am not sure that this was previous to her rheumatic attacks. Since her death he has written to me that she had shown cardiac and renal symptoms while under his care, but that he had examined the urine twice without discovering albumen or sugar. As we had ausculted her heart and found no special lesion, as her physician had discovered no albuminuria, and as she had taken ether twice previously without trouble, she *was* a proper case for etherization. It was negligent, however, in us at the time of operation not to inquire into the condition of the kidneys; for then we did not know of Dr. West's negative analysis. Hundreds of patients are etherized every year without a urinary analysis being made; among whom some certainly have Bright's disease. Although the discovery of albuminuria would not have deterred us, as the operation could not have been performed without it, still, as it is well known that renal disease prevents the ready elimination of the anæsthetic, every surgeon should take the preliminary precaution of examining the urine at least in cases of chronic disease.

Was the ether properly given? The amount used was small, it was given, sprinkled upon two towels, by a resident who was accustomed to using ether, it was of Squibb's manufacture, and produced during the inhalation nothing to attract

the administrator's attention. Hence it may be assumed that this question can be answered affirmatively.

It seems, indeed, that ether could hardly have been administered to any patient and under any circumstances better calculated to dispel anxiety. There was no special heart-lesion observed, there had been no albuminuria, there was no cutting operation to cause shock, the quantity of ether was small and of the best quality. Yet she died.

Was the treatment of the patient after dangerous symptoms occurred conducted properly? I think we may say that it was. The only indication of danger observed was the rapid and feeble pulse; the respiration was not bad, and the unconsciousness appeared to be merely such as is often seen after full anæsthesia. In fact, one gentleman remarked that she merely seemed to be sleeping off the anæsthetic. The indication for treatment then seemed to be cardiac stimulation, which was attempted by digitalis and whisky. The main reliance was upon the former, for the enema of whisky (f3vj), though comparatively large, would not be absorbed very rapidly; and the spirit given hypodermically was in small amounts and at considerable intervals. It is well known that belladonna is claimed as advantageous in shock and in respiratory failure: hence the atropia given was not inappropriate, although respiration was good and not irregular until near the fatal termination. Morphia was suggested, but the comatose condition of the patient seemed to me to contra-indicate its use. Nitrite of amyl and the battery, which was indeed used for a short time, were, I believe, appropriately rejected. Is it possible that hot-air baths would be available in such conditions by causing cutaneous elimination of the anæsthetic? I know nothing clinically on this point, which I merely throw out as a suggestion.

How did ether produce death in this instance? The recent report to the Scientific Grants Committee of the British Medical Association states‡ that the chief dangers in anæsthesia are—1, sudden stoppage of the heart; 2, reduction of blood-pressure; 3, alteration of the pulse-respiration ratio; and, 4, sudden cessation of respiration. The danger from ether, it is said by the same report, approaches from the pulmo-

* Medico-Chirurgical Transactions, 1872, p. 8.

† American Journal of the Medical Sciences, July, 1880, pp. 201, 202.

‡ British Medical Journal, December 18, 1880, p. 971.

nary rather than from the cardiac side. I believe that, as a rule, danger from ether is shown by the respiration, and I always in etherizing have watched the respiration with more care than the pulse; but this custom, which is general among surgeons, I now feel is founded upon error. The patient whose case I am studying did not present any special respiratory symptoms until more than a half-hour had elapsed from the time that the circulatory symptoms presaged imminent death. She was evidently dying long before respiration showed any sign of her danger. The pulse-respiration ratio was greatly altered, for with a feeble pulse beating 180-200 per minute the respirations were very little above normal. It was this rapid feeble pulse that struck me with astonishment, when every other clinical appearance seemed to indicate safety.

We have become too much inclined to look upon ether as having no depressing effect on the heart. If we examine clinical evidence and that deduced from experiment, we shall find that ether does at times depress the heart, but much less actively than chloroform. The Committee of the Royal Medical and Chirurgical Society stated in 1864 that ether exerts but a very slight depressing influence on the force of the heart's action.* This authoritative statement of the slightly depressant effect of ether on the heart, which has been reaffirmed and repeatedly proved, has led us to look upon it as almost an impossible thing for ether death to occur from cardiac failure. Many readers perhaps have neglected to continue the perusal of the above report to the modified statement that "ether destroys life partly by enfeebling the action of the heart, but chiefly by arresting the movements of respiration."†

Kappeler says it is by no means apparent that ether death in human beings always begins by disturbance of respiration and proceeds from the respiratory system.‡ Dr. J. C. Reeve believes it to be an error to think that there is a difference in regard to the actions of chloroform and of ether upon the nervous centres of respiration and circulation,§ and says that Kappeler reports

three instances of sudden cardiac death from ether. In speaking of the comparative safety of ether, ethidene dichloride, and chloroform, the report to the British Medical Association asserts that the circulation is more readily established when its cessation is due to ether, than to the two other anæsthetic agents;|| which statement infers that ether may produce dangerous cardiac depression.

This evidence all tends to show that surgeons lay too much stress on the respiratory action of ether, and perhaps administer it carelessly because they feel that respiration is easily watched during anæsthesia, and that artificial respiration can immediately be instituted. Some writers have attributed perfect safety to ether, and have even gone so far as to state that if complicated instruments are avoided and nothing but the towel and sponge used there is absolutely no danger.¶

All this is wrong. Every man should feel that anæsthesia, which places many of the animal functions in abeyance, is akin to death, which is merely the additional obliteration of circulation and respiration. All anæsthesia is dangerous, though the degree varies with the agent.

There is certainly no doubt that death in the instance before us was due to ether given to a patient not specially obnoxious to the agent, and given in the usual manner; and that death resulted directly from cardiac depression without respiratory symptoms.

In glancing over the four cases presented for your consideration, I may make the following summary. The woman (Case I.), whose death I have been discussing, certainly died because of the influence of ether upon the heart; the man (Case II.), whose sudden collapse occurred after the ether had been pushed, possibly succumbed to its cardiac depression also, though the notes are not sufficient for an accurate determination; the young man's death (Case III.) was due to oedema of the lungs resulting secondarily from etherization; while the bromide of ethyl case (Case IV.) presents a history pointing to cardiac paralysis as the cause of the fatal issue. In the first two and the last case death was primary, because the patients never awoke from the anæsthetic sleep; in the third it

* *Medico-Chirurgical Transactions*, 1864, pp. 333, 334.

† *Ibid.*, p. 351.

‡ See Review in *Amer. Jour. of Med. Sci.*, July, 1880, p. 209.

§ *Cincinnati Lancet and Clinic*, October 30, 1880, pp. 387, 388.

|| *British Medical Journal*, December 18, 1880, p. 971.

¶ *Jonathan Hutchinson*, *British Med. Jour.*, November 6, 1880, p. 760.

was secondary, because the asphyxia due to pulmonary œdema supervened after consciousness had returned.

How are ether deaths to be avoided? This is, after all, the question of paramount importance, that forces itself upon every one. It has been suggested by Dawson of Leeds* that the fatal effects of ether are due to the pulmonary circulation being impeded by capillary contraction caused by the cold produced by the ether. Then embarrassment of the right heart occurs because of the unusual resistance it has to overcome. These and other theories belong to physiology rather than to clinical surgery; and I shall not stop to discuss them. It would seem that death from ether anæsthesia may occur at times when there is no reason in the patient, or in the method of administration, to expect such a result. It is imperative upon us all, however, to take every precaution to avoid such an occurrence; and yet I am convinced that no powerful drugs are administered as carelessly, as recklessly, and by as incompetent hands as anæsthetics. Let every one remember that an anæsthetized patient is really a patient with one foot in the grave, and he will feel the responsibility that rests upon him when he gives an anæsthetic. Lungs, heart, and urine should always be examined before the administration, for, though lesions here should not preclude anæsthesia when necessary, the knowledge of such lesions would enforce caution and care. I have seen persons profoundly anæsthetized without the least examination or inquiry having been made as to these organs. I have seen them left by the physician before they had regained perfect consciousness. I have seen ether given by persons who knew nothing of its dangers or the methods of averting evil results. Every member of this Society, including myself, has probably been guilty of these things; and yet we are astonished when a patient dies from ether. The wonder really is that ether deaths are not more frequent than they are.

Anæsthesia is partial death, and one step further is death. Hence the man intrusted with the ether towel at an operation should be the most skilful of all the assistants. In many instances more skill is required in the administration of the anæsthetic than in the performance of the operation. Yet this duty is generally rele-

gated in hospitals to the junior residents, and in private practice often to the nurse or a layman. It would be useless and improper for me to attempt to instruct this body in the method of giving anæsthetics, for you all have given them frequently. The only point I desire to enforce upon your attention is, "Take care. All anæsthesia is dangerous." Ether anæsthesia is less so than chloroform anæsthesia; and hence I believe, as I have elsewhere written,† that chloroform should be rejected entirely as an anæsthetic in practical surgery. If anything safer than ether is found, we must reject ether.

Anæsthesia is undoubtedly essential in surgery, medicine, and midwifery, and is properly resorted to in cases of cardiac, pulmonary, and renal disease when necessity demands it. In many cases the risk without it would be greater than the risk with it; but it should be regarded as a powerful agent for evil as for good. Unfortunately, we have, as yet, no infallible means of predetermining which cases will be instances of death from anæsthesia.

A report of all the ether deaths that have occurred in the last few years would be a valuable aid in studying the fatal action of the agent, and I have therefore appended to this paper a list of those that I have found recorded since January, 1872.

In the *British Medical Journal* for March 2, 1878, pp. 290, 291, Mr. Cawtley Dawson gives the histories of eighteen cases of so-called deaths from ether, occurring during the years 1873, '74, '75, '76, '77. In this list, however, he records some cases which should not properly be claimed as deaths from ether. He eliminates nine, and accepts the remaining nine cases, in which he thinks ether was the cause of death. Of these he gives a tabulated statement. Among the number rejected by him is the case reported by me (Case III.) as a death from œdema of the lungs after ether. He also rejects the case marked No. 14 in his list, for a similar reason,—namely, that death was caused by previous pulmonary trouble aggravated by ether. These should certainly be regarded as deaths resulting from etherization. His case No. 13 was that of a patient in whom cerebral hemorrhage was found after death. This appears from the short account to have been caused by the etherization, and should not be rejected. These three cases, added to the nine which he accepts, would make twelve instances of ether death; but I reject his accepted case

* *British Medical Journal*, March 2, 1878, p. 289.

† *Transactions of the Medical Society of the State of Pennsylvania*, 1880, pp. 152, 153.

No. 16, because^{*} chloroform was mixed with the ether, and the woman died one minute after the beginning of inhalation, possibly from the small amount of chloroform in the mixture.

Hence I have from him eleven cases of primary and secondary ether death, of which No. 1 is Case III. of my present paper. To these the two other ether cases in this paper may be added, making thirteen cases in all.

Continuing my search, I have found reported during 1878, 1879, 1880, seven other cases.

I. *British Medical Journal*, May 18, 1878, p. 730. Man, aged 50 years; strangulated hernia for four days; London Hospital. Ether, 1½ ounce, given for examination of hernia; respiration ceased, and pulse beat for one and a half minutes afterwards. Left ventricle contracted; heart apparently healthy; lungs extremely congested; kidneys slightly granular, but not congested; commencing peritonitis.

II. Turnbull's *Artificial Anæsthesia*, 2d ed., p. 47. Mr. G. W. Callender, surgeon to St. Bartholomew's Hospital, London, told author of a case occurring in that hospital before his visit to America. Patient was admitted for intestinal trouble. This may be the same case as No. III. below.

III. *London Lancet*, Am. ed., Nov. 1880, p. 420. Reported by R. N. Hartley; operator, Mr. Teale. Man, aged 66 years; intestinal obstruction; ether by Clover's small inhaler, a little over one ounce. After fifteen minutes, while surgeon was operating for colotomy, the man vomited, took a deep inspiration, then appeared about to vomit again, but sank on pillow and died; pulse was good when he first vomited. This seems to be a death from interference with respiratory action.

This may be the same case as that mentioned above by Turnbull.

IV. *British Med. Jour.*, April 12, 1879, p. 562. Girl, 8 years; strabismus; Moorfields Royal Ophthalmic Hospital. Ether and a little chloroform; discharged two or three hours after operation, and removed to home by mother; died collapsed about seven hours after operation. No autopsy given. Not established as a true ether death.

V. *British Med. Jour.*, February 7, 1880, p. 215; from *Boston Med. and Surg. Jour.* for January, 1880. Man, 55 years; hip-injury; ether for diagnosis; in Providence; respiration stopped after fifteen minutes of inhalation. Serum beneath arachnoid, valvular disease of heart, cystic degeneration of kidneys.

VI. *British Med. Jour.*, February 7, 1880, p. 215; from *Canada Lancet*. Lady; extraction of teeth; scarcely one ounce used; death from paralysis of the heart.

VII. *Cincinnati Lancet and Clinic*, October 30, 1880, p. 380. Dr. N. P. Dandridge's case. Woman, 43 years; necrosis of femur; had been etherized twice, only a short time

before, for same disease in same hospital; operation begun, when it was noticed that there was no respiratory motion and no pulse; reacted slightly, but died in about two and a half hours. Lungs healthy, except a few emphysematous blebs; heart-muscle and valves apparently normal; kidneys showed no structural change, but were anæmic.

Of these seven cases, Nos. II. and III. are probably the same, and No. IV. is not a pure ether death, because chloroform was also given: hence we have really but five cases properly attributed to ether. These five, added to the thirteen cases mentioned previously, give eighteen cases of death, fairly attributed to the effects of ether, that have occurred between the years 1873 and 1880 inclusive.

Kappeler, in his article on Anæsthetics in Billroth and Luecke's "German Surgery,"* gives thirteen fatal cases occurring subsequent to 1872;† but I am unable at present to refer to the original work, and cannot compare the cases with Dawson's and my own list.

In *British Med. Jour.*, December 18, 1880, p. 997, Mr. Burton and Dr. Jacob give eleven cases of death occurring during and after administration of ether in Great Britain and Ireland from 1870 to 1880. These correspond in many instances, of course, with Dawson's list.

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1118 ARCH STREET.

DISCUSSION UPON ANÆSTHETICS.

Dr. Henry H. Smith inquired whether the patients had taken food shortly before using the anæsthetic agents.

Dr. R. J. Levis said that in three of the cases no food had been taken for several hours.

Dr. Laurence Turnbull observed with much force that no anæsthetic can be used with absolute safety. Ether produces inebriation like alcohol, and the patient must be kept warm while under its influence, or the temperature will sink below the normal, the skin become cold and clammy, with symptoms of collapse. The pulse-rate falls, the breathing becomes embarrassed, and an increase of secretion takes place in the lungs, and death occurs from pulmonary œdema and respiratory paralysis, just as in drunkards who are exposed to cold. On account of the similarity of their action, alcoholic stimulants should not be given where a patient appears to be sinking after ether administration. This is the difference between ether and chloroform: under ether the pulse rate is regular and becomes slower, while under chloroform it becomes irregular, as is shown by sphygmographic tracings made by Kappeler. In ether administration the respiration should be watched; in chloroform, the pulse.

Primary deaths from ether are very rare, and that reported by the lecturer was the first one that he had heard of in the city, although another had been lately reported in Cincinnati. In the case referred to this evening, he regretted that the heart had not been carefully examined and the state of the secretions had not been noted. He believed that the state of albuminuria added increased risk to anæsthesia, and he would hesitate to give ether when the amount was large, and would seek to reduce it first by remedies. He criticised the treatment of the patient after the operation, saying that artificial respiration and warmth would have formed a better means of treating ether collapse than alcoholic stimulants. Atropia, also, should not be given in doses larger than one-sixtieth of a grain, nor too frequently repeated.

Dr. Geo. Hamilton said that if albuminuria is a contra-indication to the use of anæsthetics, he wondered that there were not more deaths, since the condition is quite prevalent.

Dr. Levis remarked that the neglect of artificial respiration had been pointed out, but if the members would look at the report they would notice that the breathing never failed until the last, while the pulse was quite weak. After the operation the patient seemed to be in a quiet anæsthetic sleep, but the weak pulse had attracted Dr. Roberts's attention.

Prof. H. C. Wood endorsed Dr. Turnbull's remarks about alcohol and ether, and said that the more closely their effects on the lower animals are studied, the more closely are they seen to correspond. Atropia and digitalis, on the other hand, are of value, but their effects have been greatly magnified; as in single doses they could be given in much larger doses than we are accustomed to, and without any harm.

In considering the causes of death after ether, we must not forget that patients sometimes die of heart-failure, collapse, or shock after operations where no ether has been given. Cases of severe burns, or of surgical operations, frequently rally after the operation, but die afterwards with secondary syncope. The danger of shock is very much reduced where the anæsthetic is used, and in cases of albuminuria the danger from shock without the anæsthetic might be greater than from the ether. Moreover, the amount of albumen in the urine is not an index of the increased risk, for in some cases of contracted kidney the proportion is very small. In the treatment of collapse after ether he recommended the use of ammonia, digitalis, and proper attention to the position and covering of the patient.

Dr. Schapringher had observed that the peculiarity in the case of Dr. Roberts was the heart-failure after ether; but the case was very different from the fatal cases of sudden heart-failure following the administration of chloroform, as it came on gradually and was accompanied by a weak, rapid pulse. He had given chloroform very frequently, and had seen no bad results from it, except in one case, where an assistant had given too much, and some difficulty was experienced in reviving the patient by artificial respiration, slapping his face with a wet towel, which is a good way of supplying the brain with blood and keeping up the circulation.

Dr. W. R. D. Blackwood thought that the danger of anæsthesia is often underrated. Many practitioners give chloroform for the most trifling operations, such as pulling teeth or opening a felon, which is unjustifiable in any case, and criminal in the hands of dentists and other uneducated or semi-medical persons. He could not agree with the lecturer that chloroform should be abolished, as he had used it in many hundreds of cases,

while in the army, without any accident. He had seen a man die on the table from fright and shock before anything had been done to him; and here the anæsthetic would have been blamed if administered. He had given chloroform to men apparently dying, in order to perform amputation, and the patients afterwards recovered. Chloroform is the best anæsthetic we have, and is safe, provided that it is given with proper care. In all his field-experience he never saw any difficulty with chloroform; but it was always given in well-ventilated tents or in the open air. The only trouble he had observed with other operators was where mixtures have been used, the rates of evaporation of the ingredients being very different. For the resuscitation of such cases he recommended the introduction of a piece of ice into the rectum. Ether is, however, in ordinary civil practice the preferable agent, and is always safe.

Dr. Lewis introduced Dr. West, who was invited to give a further account of the fatal case, which had been under his care previous to the operation.

Dr. West said that the patient had been under his care for about eighteen months previous to her admission into the hospital. After three months' treatment for uterine disease, she had an attack of rheumatism, and subsequently a relapse; she continued sick for about three months. She also complained from time to time of dysuria, but no albumen or sugar was detected in the urine; but from the pains in the kidneys the speaker inferred that she had chronic nephritis. She also had occasional cardiac palpitation, but had no other evidence of heart-trouble. Twice before admission into the hospital she had taken ether without bad symptoms, although the symptoms of cardiac trouble had previously existed.

Prof. Bartholow said that the prevailing impression of the profession of the comparative safety of ether over chloroform makes a careful investigation into fatal cases necessary, in order to ascertain all the causes contributing to the result, so as to avoid them in the future. He had been struck with the general neglect by the profession of the observations upon anæsthetics made by Bernard some twenty years ago, who found that anæsthesia could be obtained more easily, maintained with less danger, and after-recovery made more sure, by the administration of morphia just before the anæsthetic is given; by this means the stage of excitement and rigidity is avoided which constitutes one source of danger. He also claimed that by this mixed anæsthesia the sensibility of the larynx was obtunded so that the agent could be given with less trouble. He also was satisfied that less of the agent was required, and the stage of anæsthesia was prolonged. Nussbaum adopted the method, but administered the morphia

after the patient was under the anæsthetic influence. By the method of mixed anæsthesia the danger is lessened; for nothing could be more certain than that morphia sustains the action of the heart. It is therefore a matter of surprise that the profession at large has taken so little notice of this method of Bernard, especially when endorsed by Nussbaum. It is true it has been advocated by Wm. Warren Green, who claimed it as his own, and it was also taken up by Dr. Reeve, of Dayton, who wrote a paper on mixed anæsthesia. The morphia should first be given by the hypodermic plan, and the anæsthetic subsequently; less of the chloroform will be required, and the danger of heart-failure will be reduced.

He had also been impressed with the statement that the condition of anæsthesia is a condition of danger. All the functions of life are suspended except circulation and respiration, and these are in a more or less damaged condition. Our attention, then, should not be directed to the search after new anæsthetic agents so much as in the direction of making those we have safer. He did not believe that ether is necessarily safer than chloroform. The agent that is used the most frequently would naturally yield a greater number of deaths, and when ether comes into more general use more deaths from it may be anticipated. If anæsthesia is a condition of danger, then the danger is present with ether as well as with chloroform.

In the treatment, he fully agreed with the statement of the inadvisability of giving alcohol in any form, especially hypodermically: as ether is a derivative of alcohol, and has the same effect as a respiratory paralyzer, it would only be adding fuel to the flame. Nor could he agree with the treatment by the injection of ammonia. Where there is danger of death from paralysis of respiration, there are two means of stimulation far superior to medicine: they are artificial respiration and faradism, which are far better in these cases than the so-called cardiac stimulant, atropia. If the cardiac ganglia are beginning to fail from exhaustion, the cardiac stimulant may meet with no response, or may prove injurious, for its first effect is that of stimulation; the second, exhaustion. The heart may be sustained by intravenous injection and artificial heat. He most decidedly protested against the subcutaneous injection of the tincture of digitalis. The action of digitalis is slow, and requires several hours to affect the heart. In a case reported by Boehm, death occurred five days after the administration of a poisonous dose of digitalis, from paralysis of the heart. Digitalis acts by stimulating the inhibitory apparatus, and not by giving increased power to the cardiac ganglia.

Dr. Huidekoper endorsed mixed anæsthesia.

Dr. Toboldt suggested nitrite of amyl in syncope after anæsthetics.

Dr. Henry H. Smith was present at the first administration of ether in this city. In 1846 he administered it for Prof. Horner, in the case of a woman whose breast was to be amputated: the patient was fully anæsthetized, to the great delight of the class. In spite of opposition and warnings of threatened litigation, they continued to use it at the clinic. The surgeons of Pennsylvania Hospital spoke very strongly against it, and one of the more prominent would not consent to be present where it was used. A leading obstetrician warned him that, as it was against the teachings of the Bible, it should not be used.

The first case reported by the lecturer was not a death from ether, but from shock. He recalled a case in which *brisement forcé* had been practised upon an ankylosed knee, without any anæsthetic, and the patient died twelve hours afterwards from shock. The state of anæsthesia is not without danger, but with proper precautions it is perfectly safe. The patient should not be smothered with a towel, but allowed to have fresh air. A bottle of ammonia should always be convenient, so as to allow the patient to inhale it if the breathing is imperfect. He had given ether for the last thirty years to cases in his clinic, and in private practice, amounting to several thousand, without the slightest cause for anxiety. Even in cases of valvular disease of the heart, and in old age, he had used it without bad results. He insisted upon the importance of not allowing the patient to have any solid food on the day of operation, not since the evening previous.

He believed the danger to be greatly enhanced where mixtures are used. Physicians, moreover, should not be satisfied to use any anæsthetic without ascertaining its purity; the tests being easily applied. As he had no experience in the treatment of dangerous symptoms following anæsthetics, he would not discuss the subject, but said that he questioned the utility of hypodermic injections, and would prefer inversion of the patient, artificial respiration, and frictions of the skin.

Dr. Chas. B. Nancrede observed that in the popular estimation the danger from anæsthetics could not be very great, as they are generally intrusted to the youngest resident physicians in the hospital, and he had seen them thus given in the most reckless manner, so as to nearly strangle the patient. He was surprised that there were so few deaths.

One point not referred to was the effect of the ether upon the broncho-pulmonary mucous membrane. It is well known to act as an irritant, and to cause increased secretion. Under such circumstances, there is increased difficulty in forcing the blood through the capillaries, and the heart's action is reduced; this apparent weakening of the heart is not due to direct depressing action of the ether, but is caused by the difficulty in the capillary

circulation. Artificial respiration will relieve this trouble.

As regards shock, he doubted if ether prevented it, as had been asserted. After a major operation he had seen great irregularity of the heart, due to the operation, and not the anæsthetic: if the patient had died, he would not have perished from the ether, but from the operation; he would be more likely to die without the ether.

In conclusion, he condemned the practice of pulling the tongue forward and holding it pulled out of the mouth, as this manœuvre by fixation of the larynx rather interfered with than assisted breathing; the method of pulling the jaw forward by placing the thumbs behind the angle on each side, on the other hand, greatly favors respiration.

Dr. O'Hara did not consider albuminuria as a contra-indication to anæsthesia, especially in cases of convulsions. The greater danger of chloroform over ether may be explained by its different specific gravity. The patient reported by Dr. Roberts may have had simply a weak heart; the absence of murmur is not conclusive evidence that the heart was healthy.

Dr. Albert H. Smith in obstetric practice preferred chloroform to ether, because it acted more promptly in relieving pains, but for prolonged operations he used ether and morphia, as recommended by Bernard.

Dr. John H. Packard referred to the use of nitrous oxide preliminary to the administration of the ether. He had not seen any ether deaths in healthy persons; they were all debilitated or reduced by chronic disease; among the chloroform deaths, however, some were included who appeared to be perfectly sound and healthy. Perhaps when ether has been given in as many cases as chloroform there will be just as great a mortality. In cases of death, the mere phrases "disorder of the heart," "diseases of the lungs," etc., are not sufficiently explicit; the profession wants to know what diseases of the heart, what was the condition of the lungs, as whether emphysema, chronic bronchitis, or the like. He had given ether in old drunkards with good results, and also in cases of albuminuria, which did well.

Secondary shock may follow operations after chloroform as well as after ether, and occurred before the introduction of anæsthetics.

In giving ether, no air should be admitted, but only ether vapor. If epileptiform convulsions occur, dash cold water in the face of the patient, and no bad results will ensue. The ether should be given on a towel folded into a cone, with only a small aperture at the top. In conclusion, he called attention to the similarity of the measures adopted in the treatment of Dr. Roberts's case and that occurring recently in Cincinnati.

Dr. A. G. Read believed that the very large amounts of brandy which had been thrown into the rectum and under the skin in the

case just referred to were enough to cause a stoppage of respiration in a healthy person.

Dr. Chas. K. Mills called the attention of the Society to the recently-reported experiments of Brown-Séquard in producing general insensibility by dropping chloroform upon the skin. He thought it possible that in some of the cases of unfavorable effects in man the result might be explained by the local action of the chloroform.

Dr. Jos. Hearn, as anæsthetizer for the Jefferson Medical College, had given chloroform in many thousands of cases in the last eleven years, to young and old, without any bad effect. He advised giving the anæsthetic gradually, so as to accustom the patient to it; it may then be kept up for hours. Where much irritation is caused, it may be due to impure ether; chloroform does not cause such irritation. He always has a wet towel at hand to slap the patient's face as soon as he appears asphyxiated. He watches both the respiration and the circulation. He believed that the danger of chloroform upon the heart had been overrated. The use of morphia prior to operation is generally practised at Prof. Gross's clinic, as it requires less of the anæsthetic. The primary irritant effect of the ether can be obviated by practising Dr. Bonwill's method of rapid respiration to obtund the sensibility of the mucous membrane.

When the chloroform or ether is carefully given, the danger is comparatively small; the risk is less in the agent than in the mode of administration. He had never seen a death from either chloroform or ether.

Dr. Roberts said that in the case he had reported the question as to whether death was due to shock or not was very appropriate, since

the patient was much agitated and very anxious, because a very noisy sailor had been operated upon immediately before she was brought in, which had frightened her very much. Fatty embolism was also suggested as a cause of death; but there was no difficulty in respiration; for the same reason, artificial respiration was not required. The changes in the liver, kidney, and heart explained the fatal result, but they could not be ascertained previous to the autopsy. Ether gives trouble in these cases, perhaps, because so much is taken into the system, and the elimination is very imperfect; but he had reached the conclusion that ether is far safer than chloroform. Schiff and Dalton both use ether in preference to chloroform in their physiological experiments, because so many deaths are caused by the latter. Excluding deaths from mixed anæsthetics, the mortality from ether is comparatively small, since there have been reported only seventeen or eighteen cases in all. Nitrous oxide gas has been used preliminary to the ether with good results; and it has been recommended to give ether prior to chloroform administration. Mr. Dawson, of Leeds, England, was the first, he believed, to attribute the danger of suffocation from the increased secretions of the lungs to the coldness due to the ether in the bronchial tubes. The most recent authoritative statement in regard to anæsthetics was the Scientific Grants Committee of the British Medical Association, who declared chloroform to be the most dangerous, ethidene dichloride next, and ether the least. As matters stand at present, he would rather write upon a death-certificate "Death from ether" than "Death from chloroform."

